

Claims

1. A variable nozzle device (1) for a turbocharger comprising:
an annular nozzle (3) formed between an inner wall (11) and an outer wall (10), and
an annular arrangement of adjustable vanes (4) interposed in the nozzle (3) for defining a plurality of nozzle passages,
wherein the nozzle (3) is adjustable by controllably adjusting the vanes (4) and by controllably varying an axial clearance between the outer wall (10) and the vanes (4).
2. A variable nozzle device (1) according to claim 1, wherein the outer wall (10) is axially moved to and from the vanes (4) by an actuator, preferably a pneumatic actuator (6).
3. A variable nozzle device (1) according to claim 2, wherein the axial movement of the outer wall (10) to the vanes (4) is limited by a spacer which defines a minimum axial clearance between the vanes (4) and the outer wall (10).
4. A variable nozzle device (1) according to any one of claims 1 to 3, wherein the outer wall (10) is defined by a hollow shaft (5) which comprises an axial slit forming a bypass for exhaust gas which does not pass through the nozzle (3).
5. A variable nozzle device (1) according to any one of claims 2 to 4, comprising means for operating the axial movement of the outer wall (10) in such a manner that the outer wall (10) is moved away from the vanes (4) as an operational rotational speed of the turbocharger increases.
6. A variable nozzle device (1) according to any one of claims 2 to 5,

comprising means for operating the axial movement of the outer wall (10) in such a manner that the outer wall (10) is moved to the vanes (4) as an operational rotational speed of the turbocharger decreases.

7. A method for operating a variable nozzle device (1) for a turbocharger comprising a plurality of vanes (4) arranged in a nozzle (3) defined between an inner wall (11) and an outer wall (10), the vanes (4) forming nozzle passages, the method comprising the steps of:

adjusting the nozzle passages by controllably adjusting the vanes (4), and

varying an axial clearance between the outer wall (10) and the vanes (4) by axially moving the outer wall (10) to and from the vanes (4).

8. A method for operating a variable nozzle device (1) for a turbocharger according to claim 7,
characterized by the following steps:

increasing the axial clearance between the outer wall (10) and the vanes (4) as the operational rotational speed of the turbocharger increases; and

decreasing the axial clearance between the outer wall (10) and the vanes (4) as an operational rotational speed of the turbocharger decreases.

9. A method for operating a variable nozzle device (1) for a turbocharger according to claim 7 or 8, wherein

the step of increasing the axial clearance between the outer wall (10) and the vanes (4) starts and/or stops either independently from or simultaneously with a step of pivoting the vanes (4) for enlarging the gas flow area of the annular nozzle (3); and/or

the step of decreasing the axial clearance between the outer wall (10) and the vanes (4) starts and/or stops either independently from or simultaneously with a step of pivoting the

vanes (4) for reducing the gas flow area of the annular nozzle (3).

10. A vane pivoting mechanism for a variable nozzle device (1)
5 of a turbocharger comprising:

at least one vane (4) attached to a gear (7) and a gear device (8) being in engagement with the gear (7) so that the vane (4) is pivoted when the gear device (8) is moved relatively to the gear (7).